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No. 423

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GEOPHYSICS, ASTRONOMY AND SPACE

No. 423



## I. ASTRONOMY

### Abstracts of Scientific Articles

#### OCCULTATION OF POLARIZED RADIOEMISSION BY SOLAR CORONA

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 4, No 4, 1978 pp 191-192

[Article by A. B. Berlin, D. V. Korol'kov, Yu. N. Pariyskiy, N. S. Soboleva and G. M. Timofeyeva, Special Astrophysical Observatory, "Occultation of Polarized Radioemission by the Solar Corona During a Period of Weak Solar Activity"]

[Abstract] The high resolution and sensitivity of the RATAN-600 radio telescope makes it possible to register both the small-scale and large-scale structure of the solar wind magnetic field by the method of occultation of polarized radio sources by the solar corona. The observations described in this paper were of an exploratory nature. They were carried out at a wavelength of 4 cm using the southern sector of the RATAN-600 with a periscopic array and a detector with a cooled parametric amplifier at the input. The observations were made during the period from 9 through 14 June 1977 during a period of low solar activity with the radio telescope in a fixed position. An analysis of the curves of transit of Crab nebula through the directional diagram of the radio telescope on these days was an attempt to find the small-scale structure of the magnetic field of circumsolar plasma from the change in the position angle of the electric vector of radio emission of Crab nebula during the period of its occultation by the solar corona. The change in the position angle of the polarization vector at a wavelength of 4 cm does not exceed  $0^{\circ}.5$  and corresponds to the sectorial structure of the interplanetary magnetic field.

[420]

#### ESCAPE OF ELECTRONS ACCELERATED IN SOLAR FLARES INTO SPACE

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 4, No 4, 1978 pp 197-200

[Article by O. M. Kovrizhnykh, B. M. Kuzhevskiy and L. M. Chupova, Scientific Research Institute of Nuclear Physics Moscow State University, "Characteristics of Escape of Electrons Accelerated in Solar Flares into Space"]

[Abstract] The conditions for the escape of particles into the interplanetary medium are determined by the magnetic fields on the sun. The specific configuration of magnetic fields in different flares is usually unknown. An attempt was made to ascertain the correlation between the fractions of flare electrons remaining on the sun and the fraction of electrons escaping into the interplanetary medium, taking into account data on X-radiation in the range 0.5-3 A published in SOLAR GEOPHYSICAL DATA and data on increases in electron fluxes with an energy greater than 30 KeV, observed on "Prognoz" satellites during the period from April 1972 through February 1974. The 32 events considered are tabulated. It follows from these data that with an increase in flare intensity and the number of accelerated particles there is also an increase in the fraction of particles escaping into interplanetary space.

[420]

#### ELECTROMAGNETIC LOSS-CONE INSTABILITY AND TYPE-IV RADIOEMISSION

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 4, No 4, 1978 pp 193-196

[Article by A. V. Stepanov, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Siberian Department USSR Academy of Sciences, "Electromagnetic Loss-Cone Instability and Type-IV Solar Radioemission"]

[Abstract] Type-IV solar radioemission is caused by particles trapped in a coronal magnetic trap. The relativistic particles generate synchrotron radiation. Superthermal nonrelativistic particles, having a distribution with a loss cone, generate high-frequency plasma waves which are then transformed into electromagnetic waves. The increment of electromagnetic instability is less than the increment of plasma instability. But since an insignificant fraction of the energy of the plasma waves is transformed into electromagnetic radiation, the question arises as to whether the linear mechanism of pumping of electromagnetic waves in the sources of type-IV bursts can predominate over the nonlinear plasma mechanism. The linear mechanism of generation of electromagnetic waves and its role in the origin of sporadic solar radioemission have been repeatedly examined, but no allowance has been made for the peculiarities of particle distribution in coronal magnetic traps. The author has taken into account the existence of a loss-cone and has determined the conditions under which the linear mechanism of generation of type-IV radioemission can predominate over the two-stage plasma instability mechanism. It was found that in sufficiently strong magnetic fields the linear mechanism of generation of radio emission by electrons with an energy of about 50 KeV can predominate over the nonlinear plasma mechanism.

[420]

## OPTICAL SYSTEM OF AZT-24 TELESCOPE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, 1978  
pp 21-23

[Article by M. V. Lobachev and K. M. Gruzdeva, "Optical System of the AZT-24 Telescope"]

[Abstract] The AZT-24 telescope is a universal instrument having a broad range of image scales. The diameter of the main mirror is 1,100 mm. It has a 1:7.25 system with a field aberration corrector. The telescope is designed for operation in the secondary focus when photographing star fields on a large scale. The optical system in this case has a single-lens afocal meniscus-like corrector of field aberrations. (The characteristics of monochromatic and chromatic aberrations are discussed.) The aberrations for a point on the axis are determined by position chromatism which in the spectral range of wavelengths from  $\lambda_1 = 312 \text{ nm}$  to  $\lambda_2 = 1,100 \text{ nm}$  gives a circle of aberration  $0.25''$ . For a point away from the axis the coma in this same spectral interval does not exceed  $0.18''$ . The circle of aberration caused by astigmatism and image curvature does not exceed  $0.8''$ . There is a 1:7.25 system without a corrector. This system does not have chromatic aberrations and for a point on its axis the aberrations are corrected. For a point away from the axis with a field  $2\ell' = 46 \text{ mm}$  the coma is  $0.7''$  and astigmatism and image curvature are  $0.8''$ . There is a fixed focus system 1:16. This system is designed for work with spectral and other instrumentation mounted in a fixed focus and operating with a small field of view. The system field of view is  $4'$ , which corresponds to an image  $2\ell' = 20 \text{ mm}$ . Astigmatism and curvature are small. Coma is  $0.45''$ . There are no chromatic aberrations in this system. There is a 1:32 fixed-focus system. The system is designed for obtaining direct photos of the star sky at a scale increased in comparison with the 1:7.25 system. There is a lens corrector fabricated from quartz glass which ensures telescope operation in a broad spectral range. Lens diameter is 280 mm. Image quality for a point away from the axis is characterized by a circle of aberration for the edge of the field which in the spectral interval from  $\lambda_1 = 3.12 \text{ nm}$  to  $\lambda_2 = 1082 \text{ nm}$  is  $0.28''$ .  
[398]

## II. METEOROLOGY

### News

#### RADAR METHODS FOR REMOTE SOUNDING OF THE ATMOSPHERE

Moscow PRAVDA in Russian 12 May 78 p 3

[Article by V. Troitskiy, Deputy Director of the Gor'kiy Radiophysics Scientific Research Institute: "The Atmosphere Tells About Itself"]

[Text] It is difficult to overestimate the significance of processes occurring in the earth's atmosphere for life on our planet. But in order to predict the weather more accurately and to understand those changes which appear in the atmosphere due to human activities, extensive research is necessary.

First and foremost, precise measurements are needed of atmospheric pressure and temperature, the concentrations of water vapor and condensed moisture in fog, clouds and rain, wind direction and force, the amount of trace gases and aerosols, etc. The matter is made more complex by the fact that these parameters must be measured for each layer of the atmosphere and at points located all over the globe.

For nearly a half-century atmospheric measurements have been conducted primarily by using small balloon-radiosondes carrying thermometers, barometers and hygrometers. Readings by these instruments are automatically transmitted by radio as the balloon ascends.

Then radars began to track the flights of sondes. Data gathered using the radar make it possible to determine wind velocity and direction at various altitudes. However, these methods cannot maintain operational reception of all the necessary parameters and their changes with time. Indeed, in order to track the motion of a radiosonde the observations must be conducted for several hours. But data on the distribution of temperature and humidity in each layer, the water content of clouds, the velocity of air movements, etc. must be obtained at precisely calculated minutes and even seconds.

In the past 10 years science and technology have come close to resolving this complex problem by means of the so-called remote sounding of the atmosphere. This is done by instruments that receive and analyze the various emissions from the atmosphere.

"Active" and "passive" sounding methods must be distinguished. The former are based on the principle of a radar system -- a transmitter sends a particular pulse and from the character and intensity of the reflected signal the properties of the atmosphere along the path of its transmission are determined. Optical waves generated by a laser, centimeter-range radio waves transmitted by a radar and sound waves emitted by a sonar are used in active sounding. Passive methods are based on the monitoring of the natural thermal radiation of the atmosphere. Its maximum intensity falls into IR and radio waves which are adapted for remote sounding.

The above methods were actively developed in our country as well as abroad. The many years of investigations of remote sounding of the atmosphere in the IR range conducted at Leningrad University and with radioemission in the atmosphere at the Institute of Radio Engineering and Electronics USSR Academy of Sciences and the Gor'kiy Radiophysics Scientific Research Institute (NIRFI) are well known.

Consequently, it was at the NIRFI that a meteorological station for remote sensing of the atmosphere by reception of its natural thermal radioemission, or as it was called, a meteorological radar telescope, was first created. It was tested during special expeditions in northern and temperate latitudes, both on earth and in the air (on planes). Using the device, data were obtained at precisely calculated moments on temperature, the amount and distribution of water vapor in the atmosphere, the water content, altitude, density and temperature of clouds, as well as on wind velocity at altitudes of several kilometers. The entire team of scientists invested much work and creativity in these developments.

The results were achieved thanks to the long-term fundamental study of atmospheric radioemission which had been conducted at the NIRFI since the end of the 1940's. Even at that time atmospheric radioemission was first recorded in the centimeter and then the decimeter wavelength range. Since then a whole series of studies has been made and scientists have carried out important theoretical and experimental work.

What is the meteorological radar telescope? It is a set of instruments capable of receiving and accurately measuring radioemission in the atmosphere at the specially selected 1.6-13.5 mm wavelength range. The fact is that waves of various frequencies provide information on occurrences at specific altitudes.

Remote sounding of the atmosphere using its own natural radioemission has a number of advantages over other methods: under any weather conditions and at any time of day its use is possible. And in combination with optical, radar and acoustic sounding it makes it possible to obtain much information on atmospheric conditions, such as on carbon dioxide content, smog and the presence of dangerous impurities.

Presently being created is a more perfect meteorological radar telescope with a 1.5-m antenna and a small computer for issuing definitive data. A satellite-borne meteorological radar telescope will be made on the basis

of this system. In that case meteorological information on a global scale will be made available.

Remote sounding methods open extensive possibilities for studying the structure of the atmosphere and its processes. It will allow the concentrations of various trace gases in the atmosphere to be determined. One can also visualize the organization of monitoring of the ozone layer, which, as it is known, protects every living thing on this planet from the sun's destructive ultraviolet radiation and which itself must be protected from destruction.

Radar methods make it possible to conduct constant routine monitoring of atmospheric conditions and to obtain data on its properties on a global scale. This will facilitate long-range weather forecasting. Thus, yet another step has been taken in the creation of future methods for studying the earth's atmosphere. [5]  
[402]

#### INTERNATIONAL METEOROLOGICAL EXPERIMENT PREPARED

Moscow MOSKOVSKAYA PRAVDA in Russian 23 Apr 78 p 3

[Article by R. Akhmetov: "Bringing Rain on Wings"]

[Summary] The international plan for increasing precipitation is of great scientific and practical interest. Specialists from the Soviet Union are actively participating. The experiment, carried out within the framework of the WMO, covers an area of 50,000 square kilometers. It is to be carried out at the request of a number of countries in Latin America, Asia, Africa. Its results will serve as a basis for practical recommendations on the stimulation of rainfall... An aircraft will take off. A ground radar will track it along a definite route. When the aircraft approaches the upper supercooled cloud layers the pilot will switch on a generator. The apparatus will discharge tiny particles of silver iodide which will form the nuclei of ice crystals. Up to a trillion tiny crystals are formed from one gram of this reagent. Water vapor condenses on each of these. The tiny particles rapidly grow and become heavier. Upon entering into the warm layers of the atmosphere they thaw and dump abundant rain on the earth. A far-flung network of rain gages and other apparatus make possible a careful monitoring of the quantity of precipitation before and after processing of the clouds. Scientists will ascertain whether this results in an increase in precipitation in one zone and a decrease in precipitation downwind. Therefore, in the allocated 50,000 km<sup>2</sup> only 10,000 km<sup>2</sup> is an active zone and the remainder is a control zone. Much attention will be given to the ecological consequences of the experiment. The meteorological experiments are extremely complex and expensive. Every country participating in implementation of the project will make a material contribution. The Soviet

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Union will provide the latest instrumentation and will help in the training of specialists. Our country has accumulated much experience in developing scientific methods for the stimulation of precipitation. In the 1930's specialists in the USSR organized the Institute of Artificial Rain, later transformed into the Institute of Experimental Meteorology. During recent years large-scale experiments have been carried out at the meteorological polygon near Dnepropetrovsk with encouraging results. At a meeting in Geneva in May a final decision will be made concerning the site for carrying out the experiment. Field work will begin next year. Work with the clouds will begin in 1980 and the experiment will last five years.

[417]

## Abstracts of Scientific Articles

### OPTICAL METHOD FOR ANALYSIS OF AERODISPERSE SYSTEMS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 240, No 1, 1978 pp 51-53

[Article by Yu. V. Zhulanov, B. F. Sadovskiy and Academician I. V. Petryanov, Physical-Chemical Institute, "Possibilities of the Optical Method for Analyzing Aerodisperse Systems"]

[Abstract] In the photoelectric method for the analysis of aerodisperse systems, in addition to obvious advantages there is a distortion of the mean size and form of the particle-size distribution function. The transformation of the pulse-amplitude distribution function into the particle-size distribution function is accomplished using the dependence of amplitude of  $V$  on particle size  $r$ :  $V = f(r, n)$ . However, the form of this function is also dependent on the coefficient of refraction  $n$  of particle matter and it can be used for converting the amplitude spectrum into the spectrum of sizes only for an aerosol having a refractive index identical to the calibration aerosol. But as shown in this article, the characteristic distortions can be eliminated and measurement accuracy can be increased if a calibration aerosol which can be measured is used. When this is done the dependence  $V = f(r)$  is obtained for the necessary  $n$  value and in the necessary size range. The experimental apparatus is illustrated and briefly described. Experiments revealed a high accuracy in determining the sedimentation size of particles which is ensured by a high accuracy in measuring slit width and pulse duration. The simultaneous measurement of amplitude and size of individual particles creates a possibility for classifying them on the basis of the refraction coefficient, that is, with respect to physicochemical composition. Thus, there is a possibility not only for increasing the accuracy of a dispersion analysis of aerosols, but also making an analysis of aerodisperse systems with respect to physicochemical composition, which will make it possible to solve a definite range of problems at a new level.

[397]



### III. OCEANOGRAPHY

#### Abstracts of Scientific Articles

##### EDGE WAVES IN NORTHWESTERN PACIFIC OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 14, No 3, 1978 pp 318-327

[Article by V. V. Yefimov, Ye. A. Kulikov, S. S. Lappo and S. L. Solov'yev, Sakhalin Multidiscipline Scientific Research Institute, "Edge Waves in the Northwestern Part of the Pacific Ocean"]

[Abstract] Within the framework of a long-wave approximation a study was made of a theoretical model of the propagation of captured waves on the ocean shelf. On the basis of data from synchronous multipoint measurements of bottom pressure in the northwestern part of the Pacific Ocean the authors have computed estimates of the spectrum of wave numbers and frequencies. It is shown that the increase in spectral density in narrow ranges of frequencies and wave numbers coincides with the theoretically constructed dispersion curve corresponding to the zero mode of the captured edge waves. The nonstationary nature of the long-wave field related to the nonstationary nature of atmospheric disturbances is demonstrated.  
[390]

##### INTERRELATIONSHIP BETWEEN SHF RADIATION AND SALINITY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 239, No 6, 1978 pp 1313-1315

[Article by G. I. Chukhray and A. M. Shutko, Institute of Radio Engineering and Electronics, "Results of Experimental Investigations of the Interrelationship of the Characteristics of Superhigh Radiation and Salinity of Ocean Areas in Range of Concentrations 0-35<sup>0</sup>/oo"]

[Abstract] For the purpose of investigating the spectral dependence of the intensity of superhigh-frequency radiation of the ocean surface, specialists at the Institute of Radio Engineering and Electronics carried out experiments in the territory of the Far East from aboard an IL-18 aircraft-

laboratory. The flights were carried out in a meridional direction from the Sea of Japan to the Sea of Okhotsk over Tatar Strait, the Amur estuary and Sakhalin Gulf. A peculiarity of the selected region is the existence of minimum salinities ( $S \sim 2^{\circ}/\text{oo}$ ) in the mouth part of the Amur estuary and values close to oceanic ( $33-35^{\circ}/\text{oo}$ ) in the southern part of Tatar Strait and in the northern part of Sakhalin Gulf. The complex of on-board instrumentation included five radiometers operating at wavelengths of 2.25, 3.4, 10, 20 and 30 cm. The response of this instrumentation was  $0.5-1^{\circ}\text{K}$ . The experiments were carried out in September 1976. During the experiment the waves did not exceed 2 scale units. An analysis of the results shows that the intensity of the radiation at wavelengths greater than 10 cm decreases with an increase in salinity, and the greater the longer the wave of electromagnetic radiation. At one and the same wavelength an increase in salinity leads to an increase in the radiobrightness contrast. At wavelengths shorter than 10 cm the radiobrightness fluctuations are within the limits of measurement error with a change in salinity.

[391]

#### GEOMAGNETIC AND GEOMORPHOLOGICAL STUDIES OF KOLBEINS EY RIDGE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 240, No 1, 1978 pp 193-196

[Article by V. M. Litvin, A. Ye. Suzyumov and Ye. G. Mirlin, Institute of Oceanology, "Results of Geomagnetic and Geomorphological Investigations of the Southern Part of the Kolbeins Ey Ridge"]

[Abstract] For the purpose of study of the Kolbeins Ey Ridge region, in accordance with the program of the International Soviet-Icelandic Expedition, on the 23d voyage of the "Akademik Kurchatov" in 1976 specialists carried out detailed geological-geophysical investigations in a polygon to the north of Iceland. There were echo sounding and magnetic surveys in a system of runs both across and along the Kolbeins Ey Ridge. The survey runs were particularly close in the axial zone of the ridge, and also on the shelf, where the nature of bottom relief and the magnetic field was most complex. The polygon covered the slope and part of the island shelf along the northern coast of Iceland where the shelf is rather broad and dissected by submeridional depressions into a series of elevated sectors (banks). In its central part is the Kolbeins Ey Ridge, which rises 300 m above the shelf surface and consists of a series of parallel peaked crests separated by narrow longitudinal troughs. Figure 1 in the text is a bathymetric chart of the polygon and Fig. 2 is a map of the modulus of the total vector of the magnetic field. The magnetic field within the polygon is characterized by considerable complexity, corresponding to the complex geomorphology. The spreading rate was also computed. Ten million years ago it was 1.2 cm/year, but later decreased to 0.9 cm/year. Then 2 million years ago it increased to 1 cm/year, and remains such today.

[397]

## HORIZONTAL COHERENCE OF SEMIDIURNAL TEMPERATURE VARIATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 14, No 3, 1978 pp 340-342

[Article by Ye. G. Morozov and L. P. Filatova, Institute of Oceanology,  
"Horizontal Coherence of Semidiurnal Temperature Variations in Poligon-70"]

[Abstract] The purpose of this study was an investigation of horizontal coherence in the Atlantic Hydrophysical Poligon-70 Program in the layer of the seasonal thermocline using the maximum possible number of pairs of records. The authors studied the interrelationships between temperature variations at the 200-m horizon using synchronous records obtained at different buoy stations. The duration of these records was 12 days. These series were used in computing the spectral characteristics, obtained by Fourier transformation of the correlation function. The coherence values obtained at pairs of points separated by an identical distance were averaged. There was some decrease in coherence with an increase in distance. The high values for horizontal coherence of semidiurnal temperature variations at scales up to 100 miles, obtained by averaging of a large number of pairs of records, indicate a directed wave process causing these variations and a small number of modes present in the process. The internal waves with a semidiurnal period observed in the ocean constitute a special phenomenon caused by a specific source. These processes must be studied by special measurements.

[390]

## METHOD FOR STUDY OF STRUCTURE OF OCEAN FLOOR

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1978  
pp 102-105

[Article by Yu. B. Shaub, Pacific Ocean Oceanological Institute Far Eastern Scientific Center, "Study of Structure of the Ocean Floor by the Long Cable Method"]

[Abstract] Different modifications of magnetotelluric methods can be used successfully for studying the structure of the ocean floor. Calculations show that magnetotelluric soundings make possible the most successful determination of the depth of well-conducting layers in the earth's crust and upper mantle, whereas the remaining parameters of the geoelectric section are determined less well. But magnetotelluric methods make it possible to carry out the deepest regional investigations of the ocean floor at individual points or individual groups of points; these methods are not optimum for areal or more detailed surveys. For this reason the author has examined the possibility of active electric prospecting methods for study of the geoelectric structure of the ocean floor. The results of computations of the field of an infinitely long cable lying on the ocean floor

are analyzed. One of the problems investigated was an estimate of the possible field strength  $H_y$  at different frequencies and at different distances from the cable for determining the maximum dimensions of the polygon in which investigations can be carried out with one laying of a cable. The data collected demonstrate the real possibility of investigating the geoelectric structure of the ocean floor by active electromagnetic methods in polygons with an area of several tens of square kilometers (two polygons on either side of the cable). The computed data reveal the real possibility of studying the structure of the ocean floor by active electromagnetic methods in the range of frequencies from a few Hz or less. The principal mechanism ensuring the collection of information on the geoelectric section in this case will be energy transfer through a relatively high-resistance underlying layer of bedrock on the ocean floor.  
[385]

#### DYNAMIC EQUATIONS OF THEORY OF GENERATION OF WIND WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 14, No 3, 1978 pp 308-317

[Article by M. M. Zaslavskiy, Institute of Oceanology, "On the Dynamical Equations of the Theory of Generation of Wind Waves"]

[Abstract] The purpose of this study was a clarification of those simplifications in the initial dynamic equations for a two-layer fluid describing a water-air system which must be made for obtaining "working" equations for known models of wind wave generation. The need for such an analysis is dictated by the already obvious fact that the two best-known models of this sort, the Phillips resonance model and the Miles quasilaminar model of an inverse correlation between the waves and the wind do not agree with experimental data on the rates of growth of real wind waves. It seems probable that these models are reasonable in that they take into account the effects which must be retained in a more complete theory, but since the initial equations of these theories are not derived in any systematic way from the general equations of hydromechanics, but have a model character, it remains unclear what has been omitted in them. For this reason the author has endeavored to give a systematic derivation of equations for wave disturbances in the boundary layers near a moving discontinuity. There is a discussion of the actual simplifications which must be implicitly introduced in writing the initial model equations in the already known wave formation theories.

[390]

"EXPLOSIVE" INSTABILITY OF STRATIFIED CURRENTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 239, No 6, 1978 pp 1457-1460

[Article by A. G. Voronovich and S. A. Rybak, Acoustics Institute, "'Explosive' Instability of Stratified Currents"]

[Abstract] This article discusses the phenomenon of "explosive" instability of a current, inhomogeneous vertically, in a stratified fluid in a gravity field different from Kelvin-Helmholtz linear instability. Explosive instability is manifested in a simultaneous increase in the amplitudes of waves forming a resonance triplet. In this study it is assumed that the investigated space is filled with an incompressible fluid whose density at rest is dependent on the vertical coordinate (axis directed vertically upward) in conformity to the law  $\rho_0(z)$ . In the medium it is assumed that there is a plane-parallel horizontal current with a velocity profile which is assumed to be a stipulated function of  $\rho_0$ :  $u_0 = u_0(\rho_0)$ . Using this as a point of departure, the authors fully examine the theory of explosive instability and derive equations describing the conditions under which it develops. These are examined in a specific example. The time required for the development of such instability is estimated.

[391]

#### IV. TERRESTRIAL GEOPHYSICS

##### Abstracts of Scientific Articles

##### REVIEW OF THEORY OF INTERPRETATION OF GRAVITY AND MAGNETIC ANOMALIES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 12, 1977  
pp 20-41

[Article by V. N. Strakhov, Institute of Physics of the Earth, "New Stage in Development of the Theory of Interpretation of Gravity and Magnetic Anomalies"]

[Abstract] As indicated in this extensive review, a new stage is beginning in the development of the theory of interpretation of gravity and magnetic anomalies. The article gives a brief description of the earlier stages in development of theory and indicates the principal factors responsible for the appearance of the new stage. Drawing upon 36 sources, the author organizes the article as follows: 1. Introduction. 2. Content of Earlier Stages in the Development of Interpretation Theory and Factors Responsible for the Onset of the New Stage. 3. Essence of the New Stage in Development of the Theory of Interpretation of Potential Fields and its Principal Problems. 4. Approximation Basis of Algorithms for Analysis of Potential Fields. Thus, the article summarizes the results of evolution of methodological and analytical work by the author during his 25 years of interpretation of such fields. (The author's principal contributions to this theory can be found in: IZV. AN SSSR, FIZIKA ZEMLI, No 5, 1970; PRIKLADNAYA GEOFIZIKA, No 35, 1962; RAZVEDOCHNAYA GEOFIZIKA NA RUBEZHE 70-kh GODOV, 1974; GEOFIZICHESKIY SBORNIK, IN-TA GEOFIZIKI AN UkrSSR, No 62).  
[399]

##### INFORMATION-STATISTICAL THEORY OF INTERPRETATION OF GEOPHYSICAL OBSERVATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 12, 1977  
pp 75-86

[Article by F. M. Gol'tsman, Leningrad State University, "Important Problems in the Information-Statistical Theory of Interpretation of Geophysical Observations"]

[Abstract] This is a brief review of the present status and some new ideas relating to the statistical theory of interpretation in geophysics. The principal result of the statistical theory is the creation of an extremely general and logically structured interpretation scheme and also a profound analysis of the essence of the principal elements in the formulation of inverse problems, the formulation of solution procedures and determination of the quality of solutions. One of the most important results of the theory is the assertion of the need for and the development of a method for investigating the quality of the solutions obtained, making it possible to judge the possibilities and desirability of the proposed experiments. At the present time the information-statistical theory of interpretation is used by many Soviet and foreign researchers for solving an extremely broad range of geophysical problems. Despite the intensive development of statistical theory, there are many unsolved problems: development of simple and graphic measures for judging the practical possibility of solving various geophysical problems; formulation of methods for transformations of primary experimental data, and also unknown states of objects for the purpose of contending with interfering parameters; selection of measures characterizing the complexity and time required in computation procedures and also the accumulation of computer errors; formulation of new criteria for adopting decisions, taking into account the "cost" of the decisions, the degree of complexity of the algorithms and the accumulation of computer errors, etc. The statistical theory is the natural basis for solving the mentioned problems and also for the further development of contacts between man and an electronic computer, making possible a more and more rational and economical distribution of personnel and funds.

[399]

#### METHOD FOR DECREASING GRAVIMETER ERRORS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1978  
pp 92-95

[Article by K. N. Kireyev, V. S. Kutepov, V. A. Tulin and G. V. Cheremisenov, Tula Polytechnic Institute, "Damping of a Gyropendulum Stabilizer for Reducing Gravimeter Errors"]

[Abstract] A gyropendulum stabilizer (GPS), constructed on the principle of a four-gyroscope spherical vertical, is used for matching the axis of sensitivity of a sea gravimeter with the direction of the measured vector of gravity acceleration. The mean square error in stabilizing a gravimeter relative to the true vertical under real observation conditions for modern GPS falls in the range 4-6 minutes of angle. The total error includes both static and dynamic errors, errors due to the earth's rotation and characteristic periodic oscillations. The readings of a gyro-stabilized gravimeter are influenced to the greatest degree by sign-variable stabilization errors coinciding in phase with horizontal disturbing accelerations. The phase-frequency characteristic of the stabilizer is therefore very important for

a gravimeter. In this paper it is demonstrated that by using damping of the precession oscillations of the gyromotors of a GPS and by correctly selecting its characteristic frequencies  $p$  and  $s$  it is possible to reduce the errors in gravimeter readings due to the influence of horizontal accelerations and stabilization errors. A change in the quantity of fluid is used in changing the degree of damping of the gyromotors. Tests indicate that with an increase in damping the gravimeter readings are decreased. Field tests indicate that the theoretical investigations of the effectiveness of damping of precession of gyromotors in gyropendulum stabilizers are valid. The damper should have smooth adjustment of the degree of damping, whose final value must be set in the course of laboratory tests.  
[385]

#### SPECIAL METHOD FOR INTERPRETING GRAVIMAGNETIC ANOMALIES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 2, 1978  
pp 74-85

[Article by F. I. Nikonova and A. V. Tsirul'skiy, Ural Scientific Center (Geophysics Institute), "Interpretation of Gravimagnetic Anomalies on the Basis of Classes of Potentials for Which the Inverse Problem is Soluble in Finite Form"]

[Abstract] In this paper it is demonstrated that the use of classes of potentials for which the theoretical inverse problem is soluble in finite form leads to methods which do not require a priori hypotheses concerning the number of sources and their density values. The authors investigated a specific class of potentials important from the practical point of view. A number of theoretical and practical examples are cited. (Although the method is validated here for a two-dimensional case, the method is applicable for essentially three-dimensional anomalies. The authors will explore the problem further in a subsequent article.)  
[388]

#### REGIONAL GEOPHYSICAL STUDIES OF CRUSTAL STRUCTURE IN SIBERIA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, 1978 pp 90-95

[Article by E. E. Fotiadi, V. S. Surkov, M. P. Grishin and O. G. Zhero, Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences and Siberian Scientific Research Institute of Geology, Geophysics and Mineral Raw Materials, "Regional Geophysical Investigations of Structure of the Earth's Crust in Siberia"]

[Abstract] The article examines the principal results of regional geophysical investigations carried out on a large scale not only within the limits of the West Siberian Platform and its southern mountain frame, but also



in a number of regions of the Siberian Platform in general for clarifying the structure of the consolidated part of the earth's crust -- its thickness, structure and relief of the top (morphology of the surface of the folded and crystalline basements) and the bottom (so-called Mohorovicic discontinuity) and also in a number of cases large intracrustal inhomogeneities and dislocations. Figure 1 is a fold-out map of relief of the surface of geosynclinal complexes forming the folded basement of the West Siberian Platform and the crystalline rocks of the basement of the Siberian Platform in general, compiled on the basis of data from drilling, seismic prospecting, electric prospecting and interpretation of magnetic and gravitational anomalies. Figure 2 is a large fold-out map of the relief of the Mohorovicic discontinuity. The materials depicted on these two maps are briefly summarized. As a result of the many years of regional geophysical investigations it has been possible to obtain extremely important information on the deep structure of large regions and a favorable base has been created for the planning of further geophysical work for the purpose of a more complete study of the structure and physical characteristics of different horizons in the earth's crust.

[332]

#### TECTONIC DISLOCATIONS OF EARTH'S SURFACE IN KOPETDAG

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 240, No 1, 1978 pp 151-154

[Article by S. K. Gorelov, S. Tagiyev and S. S. Chelpanov, Geography Institute USSR Academy of Sciences and Institute of Physics of the Earth, Turkmen Academy of Sciences, "Recent Tectonic Dislocations of the Earth's Crust in Southwestern Kopetdag"]

[Abstract] The authors describe recent tectonic dislocations in the relief and underlying rocks which they discovered at a number of places in the southwestern Kopetdag. This was the first discovery of such dislocations since the earthquake of 1948 and the considered region was not regarded as highly seismic. Tectonic dislocations were found in three places. The nature of these dislocations varies. The state of these dislocations also varies. Linear dislocations in the covering clayey loams retain many characteristics indicating extremely recent formation, whereas the talus has become sodded and covered with brush. Many scarps have been subjected to considerable smoothing under the influence of permanent or intermittent watercourses. It appears that the sodded talus and smoothed scarps developed for the most part in 1944, whereas fresh grabens and dislocations developed in 1973. These phenomena are indicative of an earthquake of not less than 7-8 scale units, an earthquake which transpired in two phases with an intermission of 30 years and with a shifting of the epicentral zone into a northeasterly direction. The considered region of the Kopetdag must therefore be classified as a highly seismic region with predominant development of strong local earthquakes.

[397]

## ACCURACY OF MEASUREMENTS MADE USING RADIOGEODETIC SYSTEMS

Moscow IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 5, 1977 pp 14-19

[Article by N. A. Bespalov, V. P. Glumov and V. N. Vasin, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers, "Some Problems in the Accuracy and Method for Processing the Results of Measurements Carried Out Using Radiogeodetic Systems"]

[Abstract] The problems involved in the accuracy and method for the processing of the results of measurements carried out with radiogeodetic systems are increasing due to an increase in the scales of geological-geophysical and mapping surveys, including in the near zone of the shelf, the broadening of special work at sea for which the accuracy in determining the coordinates of stations and features is 1-10 m. The article first examines the influence of errors in the coordinates of base stations of hyperbolic systems on the position of the station to be determined. (Suitable formulas are derived for this purpose.) The second part of the article gives the theoretical principles of an original method for the reduction of slant ranges to the surface of relativity, making it possible to carry out the processing of radiogeodetic information at a real time scale.  
[350]

## USE OF SPACE PHOTOS FOR STUDY OF DEEP CRUSTAL STRUCTURES

Moscow IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in Russian No 10, 1977 pp 88-95

[Article by L. F. Volchegurskiy, V. T. Vorob'yev, A. B. Galaktionov, V. V. Kozlov, K. M. Mirzayev and A. A. Romashov, All-Union Combine "Aerogeologiya," "Use of Space Photographs for Studying Deep Structures of the Earth's Crust of Petroleum and Gas Regions. Article 1. Deep Structure and Neotectonics of the Northern Caspian Region"]

[Abstract] The territory of the Caspian depression is characterized by a diversity of natural landscape-geological conditions: from the virtually sediment-free regions on the eastern margin of the depression to areas in part covered with a sedimentary cover to the regions completely covered with sediments from the left bank of the Ural River to the Volga River. The northern Caspian region can therefore be a favorable natural polygon for evaluating the possibilities of using aerospace methods for studying the earth's resources. The availability of photomaps of the Aral-Caspian region and space photos at scales from 1:1,000,000 to 1:2,500,000, obtained from aboard the "Salyut-4," and also TV photos from the AES "Meteor-18" and "Meteor-25," as well as an American satellite, have considerably

broadened the possibilities of interpretation of data for the investigated territory, making it possible to define the principal regional patterns of deep structure and the nature of neotectonic deformations. In this paper it is shown that the interpretation of space materials in combination with geological-geophysical data makes it possible to determine the principal characteristics of the structural plan of the northern Caspian region. The principal criteria for the detection of tectonic activity were the following, clearly interpreted on space photos: marked changes in phototone, regular areal repetition of a photoimage of the same type, anomalous change of river valleys, their straightened reaches, and also sites of marked changes in the direction of channels, linear, extensive relief forms, chains of depressions, scarps of lake and river valleys, etc. Figure 1 in the text is a map showing the neotectonic regionalization of the northern Caspian region compiled on the basis of space photographs; Fig. 2 is a map of the principal lineaments along the lower Volga and in the northern Caspian region interpreted from space photographs. As illustrated in this paper, the study of space photos is providing rich material for the interpretation and analysis of the tectonic structure of large regions covered by sediments and in ascertaining the latest structural plan of these territories.

[330]

#### PARAMETERS OF HF FOCAL RADIATION OF EARTHQUAKE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 239, No 2, 1978 pp 293-296

[Article by Yu. F. Kopnichev and G. L. Shpil'ker, Institute of Physics of the Earth, "Parameters of High-Frequency Focal Radiation of an Earthquake and a Model of Strong Movement"]

[Abstract] The authors use a statistical approach in determining the parameters of high-frequency focal radiation of an earthquake. It involves a representation of the power  $W(\tau)$  registered on a seismogram in the form of the sum of the regular (focal) component  $W_r(\tau)$  and the scattered component  $W_s(\tau)$ , generated by the inhomogeneity of the medium ( $\tau$  is the time from the arrival of the P wave). Such an approach makes it possible, first, to find the form and level of the focal radiation at different frequencies on the basis of teleseismic records and convert to specific regular power emitted by an element of the focus, and second, stipulate the analytical response of the medium in the near zone, which greatly facilitates computation of strong movement. On the basis of the results it was possible to propose a model of strong movement having the following characteristics: 1. The focus begins to develop from a small area and increases in conformity to the law  $L(\tau) \approx \tau$  and  $H(\tau) \approx \tau^{0.4}$ . 2. Radiation occurs isotropically from the entire area of the dislocation existing at a particular moment with a specific intensity decreasing in conformity to a law which is identical for all frequencies in the interval  $1 \leq f \leq 30$  Hz.

[353]

## SOLUTION OF DIRECT DYNAMIC PROBLEMS BY EQUIVALENT SYSTEMS METHOD

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 2, 1978 pp 79-89

[Article by E. V. Nikol'skiy, Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences, "Solution of Direct Dynamic Problems by the Equivalent Systems Method"]

[Abstract] A method for solving direct dynamic problems in seismics, leading to solution of the equation of oscillations of an inhomogeneous string, is examined. The basis for solution of the equation of oscillations is the new "equivalent systems" method, making it possible to generalize the Baranov-Kyunets method and to obtain economical difference schemes not having a "spreading apart" effect. Also examined is a series similar to the well-known ray series, but in contrast to the latter the series obtained has a precise, rather than an asymptotic character.

[379]

## TECTONIC ASYMMETRY OF THE EARTH AND OTHER PLANETS

Moscow PRIRODA in Russian No 3, 1978 pp 32-41

[Article by Yu. M. Pushcharovskiy, V. V. Kozlov and Ye. D. Sulidi-Kondrat'yev, "Tectonic Asymmetry of the Earth and Other Planets"]

[Abstract] This paper deals with the following subjects: tectonic asymmetry of the earth and moon; asymmetry in the structure of Mars and Mercury; fundamental patterns in structure of planets of the earth group. The authors show here that comparative tectonics and comparative planetology reveal an extremely important common pattern in the structure of the Earth, Moon, Mars and Mercury -- their structural asymmetry. It is manifested regardless of size, mass, density and distance from the sun. It has been surprising that the tectonic asymmetry of the planets is manifested every time as soon as it is possible to obtain from them sufficiently complete morphological and geological data. Such data are not yet available for Venus and a number of other planets in the solar system, but in light of what we now know it can be postulated that they are also characterized by global asymmetry. This is evidently a fundamental peculiarity of planets of the earth group. These planets and the moon are in different stages of evolution. The earth with its broadly propagated granite-metamorphic layer, enormous masses of granites, geosynclines and secondary oceans from the tectonic point of view is at an incomparably higher stage in its development than is Mars, much less Mercury and the Moon. On the Earth there are now powerful tectonic processes at work leading to major structural transformations: appearance of new mountain ridges and deep seas, the development of rift zones, etc. With respect to Mars, it is not active and deformations and volcanism ended there

hundreds of millions of years ago and possibly even one billion years ago. The principal characteristics of the modern structure of Mercury and the Moon were formed about three billion years ago. The moon has long been regarded by geologists as a model of an early stage in the earth's evolution. But under such conditions there is also global tectonic asymmetry. This makes it possible to conclude that the asymmetry reflects the primary inhomogeneity in the distribution of matter in the upper layers of planets of the earth group. Global structural asymmetry is a property which is stable in time. This gives an explanation for the profound difference in the development of the Atlantic and Pacific Ocean segments. The primary non-uniformity of the moon and planetary bodies of the earth group is probably related to the participation of large masses of the planetesimals type in the accretion process.

[351]

#### SYSTEM OF INTEGRAL CHARACTERISTICS OF EARTHQUAKE FOCUS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 239, No 2, 1978 pp 289-292

[Article by A. A. Gusev and V. M. Pavlov, Volcanology Institute Far Eastern Scientific Center USSR Academy of Sciences, "System of Integral Characteristics of an Earthquake Focus Determined from Displacements in Body Waves in the Distant Zone"]

[Abstract] The authors examine an idealized model of an earthquake focus. The objective is to define a system of integral characteristics of the earthquake focus which can be defined from displacements in body waves in the distant zone. These characteristics are tabulated and then are employed in examining two model cases: 1. Dislocation model. 2. Elliptical fissure. Having defined how the introduced characteristics can be ascertained from elastic radiation in the distant zone, it is shown how the results can be employed in the interpretation of seismological observations. From the discussion of the tabulated characteristics it can be seen that within the framework of the dislocation model and using specific empirically determined moments it is possible to determine, for example, the orientation of the area of the discontinuity and the position of its center of gravity, length, width and duration of the fracturing, as well as other parameters. The orientation of the dislocation area is determined independently of data on the focal mechanism and therefore can serve as a basis for an unambiguous determination of the vector fixing the direction of movement at the focus.

[353]

## METHOD FOR INTERPRETING VERY LARGE GRAVITY ANOMALIES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 240, No 1, 1978 pp 54-57

[Article by Yu. A. Tarakanov and T. N. Cherevko, Institute of Physics of the Earth and Interdepartmental Geophysical Committee, "Interpretation of Very Large Gravity Anomalies from Potential, Gravity and Plumb-Line Deflection"]

[Abstract] The paper describes a method for the unambiguous interpretation of very large gravity anomalies using three field elements at a single point -- potential, gravity and plumb-line deflection. In accordance with potential theory, the body mass and the coordinates of its center can be ascertained unambiguously, but the form of the source is incompletely determined. For this reason it is desirable that the potential be expanded with an accuracy to the moments of inertia of the body. In such a formulation the interpretation method will be approximate, but a physically clear means for increasing accuracy is an increase in the number of measured field elements (second derivatives of potential, etc.). (Due to the approximate nature of the solution the centrifugal moments of inertia of the body are considered equal to zero and the moments of inertia relative to the horizontal axes are equal to one another.) The article gives the results of an interpretation of planetary anomalies (Indian, Australian, Californian, North Atlantic). Interpretation results are given for gravity anomalies at computed depths of 0 and 400 km.

[397]

## DETERMINATION OF MAGNITUDE OF DEEP-FOCUS EARTHQUAKES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 1, 1978 pp 25-35

[Article by O. N. Solov'yeva, Institute of Physics of the Earth, "Determination of Magnitude of Deep-Focus Earthquakes"]

[Abstract] On the basis of numerous records of deep-focus earthquakes in the Sea of Okhotsk and the Kurile Islands it was possible to refine and develop a method for determining the magnitude of earthquakes on the basis of body waves at close distances. A method is proposed for constructing the calibration curves of oscillatory velocity  $\lg(A/T)^* = f(\Delta, H)$ . On the basis of experimental data on the amplitudes and periods of body waves it was possible to construct empirical curves  $\lg(A/T) = f(\Delta)$  for different source depths at some arbitrary level and the reliability of the shape of the empirical curves is ensured at the same time. Proceeding on the basis of the postulate that magnitude must be an unambiguous function of the energy of an earthquake wave regardless of the focal depth, theoretical amplitude curves are constructed which are tied in to one and the same

velocity and absorption characteristics of the medium and to one and the same source intensity. Theoretical curves are constructed for the same source depths as the experimental curves and at the same scale. In conversion from the theoretical amplitude curves to the curves of oscillatory velocity the mean value of the period is substituted in the maximum wave phase determined experimentally. For calibrating the family of theoretical curves  $\lg(A/T) = f(\Delta, H)$  use is made of an experimental calibration curve constructed for shallow-focus earthquakes in this same zone. The developed method was used in constructing the calibration functions  $\lg(A/T)^* = f(\Delta, H)$  and on their basis -- nomograms for determining from the P wave the magnitudes of deep-focus earthquakes at epicentral distances 1-15° registered by mean-period instruments of the D. P. Kirnos system.

[386]

#### EFFECT OF NONUNIFORMITY OF DISCONTINUITY ON RADIATION OF ELASTIC WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 1, 1978  
pp 18-24

[Article by S. D. Vinogradov, Institute of Physics of the Earth, "Effect of Nonuniformity of a Discontinuity on the Radiation of Elastic Waves"]

[Abstract] Earlier studies by the author described a model by means of which a shear movement occurs along an earlier developed fracture. By means of this model it was possible to investigate the form of the radiated impulses and also the directional diagram for longitudinal and transverse waves. All the experiments with this model were carried out with a "smooth" fracture of linear form not having any peculiarities. In this new paper the author investigates the radiation from a nonuniform fracture. The cases considered are characterized by local nonuniformities exerting an influence on movement along the fracture and also a case when the edge of the fracture consists of materials of different elasticity. The described investigations indicated that the nature of the radiation from shear movement along a fracture is essentially dependent on the conditions along the edges of the fracture. It can be seen from a comparison of the records of longitudinal waves from smooth and nonuniform fractures that there is a significant change in the form of the impulse and this is reflected in their spectra. A determination of the length of the fracture by the Brune formula was possible if in this formula the velocity of elastic waves is replaced by the velocity of fracture propagation. The directional diagram at high frequencies, when the wavelength is equal to or less than the length of the fracture, differs appreciably from the diagram constructed using the low-frequency spectral components. Particularly large distortions are observed in the case of a nonuniform fracture. The amplitudes and directions of the nodal lines increase appreciably. The relationship between the seismic moment and the maximum amplitude (magnitude)

is different for smooth and nonuniform fractures. For a nonuniform fracture there is a substantially lesser moment for one and the same magnitude. A difference in the rigidity of edges of the fracture leads to an impairment in symmetry of radiation of displacement waves. In more rigid material the amplitudes are less. These results can obviously be used in the interpretation of seismological observations.

[386]

#### SPECTRAL ANALYSIS OF REGULAR SEISMIC WAVES AND NOISE INTERFERENCE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 1, 1978  
pp 110-115

[Article by S. A. Kats and S. N. Ptetsov, Institute of Physics of the Earth, "Spectral Analysis of the Field of Regular Seismic Waves and Noise Interference"]

[Abstract] The presently existing methods for studying the structure of the field of seismic waves can be classified into two groups: 1) velocity analysis and 2) frequency analysis. In solving many experimental problems it is necessary to make a separate study of the spectral structure of interfering regular waves forming the total field and also the spectral structure of noise interference. In the article cited above the authors develop a hybrid method for analyzing the structure of the total field with respect to both velocities and the frequency makeup of the individual waves forming the total field. This method is based on the use of evaluations of the autocorrelation functions, regular signals and interference obtained by one of the authors (FIZICHESKIYE OSNOVY METODA OTRAZHENNYKH VOLN V PLATFORMENNYKH USLOVIYAKH, Moscow, "Nauka," 1974). In the article it is shown that it is possible to obtain evaluations of the spectra of intensity of signals and noise interference obtained from the observed seismic wave fields. An algorithm for the horizon-by-horizon study of the frequency composition of seismic signals and interference was prepared and realized in the form of a program for electronic computers. Modeling was used in obtaining the noise-immunity characteristics for the proposed algorithm. The paper gives examples of use of the program for specific geophysical problems -- study of the frequency composition of reflected waves under complex conditions in the presence of interference, for selection of the optimum frequency filtering parameters.

[386]

#### EFFECT OF FOCAL ORIENTATION ON SPECTRUM OF LONGITUDINAL WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 1, 1978  
pp 101-103

[Article by Ye. E. Blagoveshchenskaya, Institute of Seismic Resistant Construction and Seismology, Tadzhik Academy of Sciences, "Effect of Orientation of an Earthquake Focus on Some Characteristics of the Longitudinal Wave Spectrum"]



[Abstract] A study was made of the characteristics of change in the amplitude spectrum of longitudinal waves with an increase in the duration of the analyzed segment of the record and the characteristics of change in the predominant period of the spectra with an increase in the energy class K of an earthquake, related to the position of a seismic station relative to the axes of the principal stresses at the earthquake focus. The experimental data were the records of P-waves of earthquakes of the energy classes  $K = 8.6-12.9$ . The earthquake foci were situated in the Tadzhik Depression and in the Gissarskiy Range at a depth of 0-30 km. The earthquakes were registered by VEGIK, SKM-3 and SK instruments at seismic stations of the Institute of Seismic Resistant Construction and Seismology Tadzhik Academy of Sciences. The analyzed data make it possible to conclude that the records at seismic stations distant from the nodal planes better reflect the correlation between energy class and such a characteristic of the spectrum as predominant frequency. The nature of the record of the initial part of the P-wave is dependent on the orientation of the ray relative to the axes of the main stresses. The amplitudes of P-waves at seismic stations located near the nodal planes increase with time. These records are also characterized by a weak dependence of the predominant period (the period at which the amplitude spectrum maximum falls) on the earthquake energy class. The records of P-waves at stations situated at adequate angular distances from the nodal planes are more compact. The amplitudes in the initial part of the record decrease with time. These records are characterized by a significant dependence of the predominant period on the energy class K. The results can be used in the optimum choice of records in seismological investigations.

[386]

#### WAVE FIELDS OF SOURCES IN NONIDEALLY ELASTIC MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 1, 1978  
pp 104-109

[Article by T. Ya. Barinova and A. Sh. Malikova, Tadzhik State University, "Wave Fields of Spherical Sources in Nonideally Elastic Medium"]

[Abstract] The problem of the propagation of seismic waves from spherical sources in an unbounded absolutely elastic medium has been examined in many studies but the model of ideal elasticity used is a very rough idealization. In solving dynamic problems in seismology and seismic prospecting it must be taken into account that real media have the property of considerable absorption of the energy of oscillations and as a result there is a change in the form of the record of oscillations. It appears that the properties of real media should exert an influence on the nature of oscillations of a cavity. It is therefore important to consider how significant is the difference between the complex frequency characteristics of the focus operative in absolutely elastic and nonideally elastic media. The authors

therefore examine the effect of spherical sources in a nonideally elastic medium. The following aspects of this problem are examined in detail: differential equations of motion of particles in a Gurevich model medium; waves caused by pulsations of a sphere; waves caused by radial pressure imparted to the walls of a spherical cavity; frequency characteristic of a spherical source of longitudinal waves. It is clear from the presented materials that in an investigation of the radiation of longitudinal waves in real media it is essential to take into account the influence of the absorption parameters on the frequency characteristic of the oscillation source.

[386]

#### PROSPECTS FOR FINDING PETROLEUM AND GAS ON CONTINENTAL MARGINS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 2, 1978 pp 3-16

[Article by A. Yu. Yunov, All-Union Scientific Research Institute of Marine Geology, "Structure and Prospects of Petroleum and Gas Deposits of Underwater Margins of Continents (in the Example of West Africa and East Asia)"]

[Abstract] The article describes the principal characteristics of the geological structure, the development and prospects for finding petroleum and gas deposits on the continental margins of West Africa and East Asia, the general patterns for the "passive" and "active" continental margins of the continents. The author clarifies the decisive role of the orogenic stage in their formation with a predominance of deuterogenesis for the first and epigeosynclinal orogenesis for the second. In the Atlantic Ocean type, where there is a predominance of "divergent" continental margins, there is characteristically a sharp contrast between the oceanic and continental blocks in the earth's crust along the zone of the continental slope and its foot, an absence of active modern volcanism and seismicity. In the Western Pacific Ocean type there is active present-day volcanism and seismicity with the presence of focal zones of deep-focus earthquakes. The continental and oceanic blocks are usually separated by the basin of a marginal sea, island arc and abyssal trench. Figure 3 in the text shows the principal stages in development of continental margins of West Africa and a number of marginal seas in East Asia. The relative probability of finding petroleum and gas in these different marginal areas is evaluated.

[379]

## V. UPPER ATMOSPHERE AND SPACE RESEARCH

### News

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-1007"

Moscow PRAVDA in Russian 17 May 78 p 3

[TASS Report: "'Kosmos-1007'"]

[Abstract] The artificial earth satellite "Kosmos-1007" was launched in the Soviet Union on 16 May 1978. The satellite was inserted into an orbit with the following parameters:

- initial period, 89.8 minutes;
- apogee, 384 kilometers;
- perigee, 180 kilometers;
- orbital inclination, 72.9 degrees.

[409]

[Note: Launchings of "Kosmos-1008," "Kosmos-1009" and "Kosmos-1010" were reported in the preceding issue of GEOPHYSICS, ASTRONOMY AND SPACE.]

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-1011"

Moscow PRAVDA in Russian 25 May 78 p 2

[TASS Report: "'Kosmos-1011'"]

[Abstract] The artificial earth satellite "Kosmos-1011" was launched in the Soviet Union on 23 May 1978. The satellite was inserted into an orbit with the following parameters:

- initial period, 104.9 minutes;
- apogee, 1,026 kilometers;
- perigee, 978 kilometers;
- orbital inclination, 82.9 degrees.

[419]

## Abstracts of Scientific Articles

### ELECTRIC FIELD IN PERTURBED ZONE BEHIND CYLINDER SURROUNDED BY PLASMA

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 1, 1978 pp 41-44

[Article by V. V. Smirnova, Nuclear Physics Institute, Moscow State University, "Electric Field in Perturbed Zone Behind Cylinder Surrounded by Rarefied Plasma"]

[Abstract] Investigation of the structure of the perturbed region in the neighborhood of bodies (rockets and satellites) surrounded by a plasma flow is of considerable interest. The problem of flow around a conducting cylinder has already been solved in a quasineutral approximation, that is, in a region where the electron and ion concentrations are close to one another. However, near the surface of the body the quasineutrality is considerably impaired, with the formation of a double-layer region, that is, the layer of the "screening" potential of the body itself. On the frontal surface the double-layer region is small, of the order of the Debye radius. However, in the rarefied zone behind the body it increases strongly and occupies the region comparable to the dimension of the body around which the plasma flows. The purpose of this study was an investigation of the distribution of the electric field in the double-layer region behind a conducting cylinder around which there is a flow of rarefied plasma. Specifically, a study was made of the structure of the electric field in the rarefied region behind a conducting cylinder around which there is a flow of cosmic plasma. The distribution of the electric field potential was found by means of numerical solution of the Poisson equation. Solutions are found for potentials across the body of  $-0.5$ ,  $-3.6$ ,  $-9.8$  kT/e.

[389]

### SATELLITE REGISTRY OF PROPAGATION OF SOLAR COSMIC RAYS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 2, 1978 pp 250-256

[Article by B. M. Kuzhevskiy, V. L. Maduyev, N. F. Pisarenko, I. A. Savenko and I. P. Shestopalov, "Study of Propagation of Solar Cosmic Rays from Eastern Flares of 28 May, 15 June and 2 August 1972 on 'Prognoz' Satellite"]

[Abstract] In this paper the author proposes a model of propagation of solar particles from flares occurring in the eastern hemisphere of the solar disk on the basis of experimental results presented in an earlier paper (B. M. Kuzhevskiy, et al., KOSMICH. ISSLED., 16, No 1, 64, 1978). This second part is subtitled "Model of Propagation of Solar Particles in the Interplanetary Medium." The nature of propagation of solar particles was investigated for the flares of 28 May, 15 June and 2 August 1972, registered aboard the "Prognoz" artificial earth satellite. The flares were observed at solar longitudes E 34° - E 11°. It was found that the change in the nature of variations of particle intensity occurs simultaneously with a change in the parameters of the interplanetary magnetic field. During the period when each of the increases was observed, it was easy to discriminate three regions of space with different characteristics of the medium, and this means with different coefficients of cosmic ray diffusion. 1. A region behind the shock wave front formed by the compressed solar wind and flare surge. 2. A region of space observed before arrival and after the passage of the shock wave front. 3. A region of space with an undisturbed interplanetary field. Changes in the configuration of the magnetic lines of force exert an influence on the nature of propagation of solar cosmic rays in the interplanetary medium. These changes are caused, first of all, by the influence of active regions on the formation of the magnetic structure of the interplanetary medium; second, by the disturbance of interplanetary space, which is associated with propagation of the shock front and the flare surge. The long-lived and most active regions evidently can exert an influence on formation of the structure of interplanetary space as far as the earth's orbit. The nature of propagation of charged particles generated in flares in the eastern hemisphere of the solar disk is greatly dependent on the structure of interplanetary space, which can be formed by the same active regions in which these flares emanate.

[392]

#### DAYTIME ATMOSPHERE OF VENUS DETERMINED FROM SATELLITE DATA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 2, 1978 pp 278-284

[Article by M. A. Kolosov, O. I. Yakovlev, S. S. Matyugov, T. S. Timofeyeva, Ye. V. Chub, G. D. Yakovleva and I. E. Kalashnikov, "Daytime Atmosphere of Venus Determined from the Results of Radio Probing with the 'Venera-9' and 'Venera-10' Satellites"]

[Abstract] During the period from October 1975 through March 1976 there were 17 radio probings of the Venusian daytime atmosphere during risings of the "Venera-9" and "Venera-10" satellites from behind the planet. In this article the authors present the results of investigations of the daytime atmosphere obtained by the processing of frequency data. Emphasis is

on obtaining the dependence of density, pressure and temperature in the daytime atmosphere on altitude above the planetary surface. In contrast to the case of radio probing of the nighttime troposphere, a special role is played by correct determination of the influence of the daytime ionosphere on the results of determination of tropospheric parameters. The sought-for data on the Venusian daytime atmosphere, obtained by the radio probing method, are of interest for an analysis of the processes transpiring in the planetary atmosphere. The article presents the collected data in the form of detailed tables of the determined parameters.

[392]

#### ACCURACY IN DETERMINING POSITION OF OBSERVATION STATIONS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 2, 1978 pp 15-19

[Article by V. V. Boykov, "Dependence of the Accuracy in Determining the Position of an Observation Station on the Type of Orbital Measurements"]

[Abstract] In determining the coordinates of observation stations by the orbital method, separately or in combination it is possible to use measurements of the range to the satellite and the radial component of satellite velocity relative to the station. It is apparent that the joint use of the two types of measurements will make it possible to obtain a higher accuracy in station position than when the methods are used separately. However, it is necessary to clarify how great this refinement is, whether it is a result of an increase in the number of measurements or whether it occurs as a result of improvement in the geometry of the geodetic constructions. In this article, which is a continuation of two earlier articles by the author (GEODEZIYA I KARTOGRAFIYA, No 9, pp 17-24, No 12, pp 11-22, 1975), it was possible to determine the optimum relation of the weights with which each type of measurements makes an identical contribution to the accuracy in determining the position of the observation station. Formulas for evaluating accuracy are derived.

[387]

#### ANOMALOUS ABSORPTION OF RADIO WAVES IN UPPER IONOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 1, 1978 pp 45-49

[Article by V. V. Vyaznikov, V. V. Vas'kov, Yu. V. Gruzdev, D. I. Kakuzin, L. A. Lobachevskiy, S. A. Namazov, V. A. Panchenko and I. S. Shlyuger, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation and State Scientific Research Radio Institute, "Anomalous Absorption of Radio Waves During Disturbance of the Upper Ionosphere by Powerful Radio Radiation at a Frequency Close to the Gyrofrequency of Electrons"]

[Abstract] The paper gives the results of experiments for observing the anomalous absorption of test radio waves with disturbance of the upper ionosphere by powerful radio radiation at the gyrofrequency of electrons. The experiment was carried out in March 1977 at nighttime when a powerful radio wave was reflected from the upper layers of the ionosphere at an altitude of 220-250 km. The ionosphere was disturbed by a powerful vertical sounding station operating at a frequency  $f = 1.35$  MHz. The method for carrying out the experiment is described in detail. It seems apparent that this is a case of resonance absorption by slowly forming inhomogeneities which are greatly elongated along the H field. Small relaxation times are indicative of a small transverse dimension of the inhomogeneities. It is postulated that the reason for the formation of inhomogeneities of concentration in the region of reflection of a powerful radio wave with a frequency  $\omega \approx \omega_H$  is the nonuniform heating of plasma during the dissipation of longitudinal oscillations.

[389]

#### CONTROL OF SURFACE FORM OF SPACE RADIO TELESCOPE

Moscow KOSMICESKIYE ISSLEDOVANIYA in Russian Vol 16, No 2, 1978 pp 169-178

[Article by V. N. Buyakas and Yu. V. Chekulayev, "Control of Surface Form"]

[Abstract] In the designing of the antenna for large space radio telescopes the problem arises of stabilizing the radio reflecting surface. The paper examines the problem of creating a controllable mechanical system which makes it possible to regulate automatically the surface form of such a radio telescope. The structural requirement which such a system must satisfy has been found. The control law has been proposed for one of the possible variants and the stability of a closed system has been investigated. The proposed variant for constructing a controllable reflecting surface for the antenna will make it possible to vary the focal length in a wide range, is insensitive with respect to temperature deformations, inaccuracies in fabrication and assembly, has a lesser weight than other variants and may be preferable in actual use than any variant in which there is adjustment relative to a rigid base. [In this proposed variant the surface configuration is controlled by rod systems without a supporting base.]

[392]

#### PROBLEMS RELATING TO THE MARTIAN MAGNETIC FIELD

Moscow KOSMICESKIYE ISSLEDOVANIYA in Russian Vol 16, No 2, 1978 pp 257-268

[Article by Sh. Sh. Dolginov, "On the Problem of the Martian Magnetic Field"]

[Abstract] It has been postulated by O. L. Vaisberg that Mars has its own magnetic field but it is not adequately effective for serving as an obstacle for the solar wind. C. T. Russell concludes that not only the "mean height" of the obstacle is about 400 km but on 21 January 1972 the height of the obstacle was 400 km. He also concludes that the "Mars-3" and "Mars-5" satellites did not penetrate into the Martian magnetosphere and that the observed field is the interplanetary magnetic field trapped by the planet. The purpose of this paper is to demonstrate that all the conclusions drawn by Russell and Vaysberg are erroneous and contradict experimental data. The author describes the methods and accuracy of determining the magnetic moment using data from the two mentioned satellites. It is demonstrated that the Martian magnetic field is in fact a physical obstacle to the solar wind. It is found that the strength of the Martian magnetic field can be about 1/500th of the earth's magnetic field.

[392]

#### SYNCHROTRON RADIATION FOR CALIBRATING UV- AND X-RADIATION RANGES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 2, 1978 pp 217-225

[Article by V. A. Kochubey, "Synchrotron Radiation as a Source for Calibration for Instruments Used in Space Research in the UV- and X-Radiation Ranges"]

[Abstract] Various reviews have contained sufficiently precise information concerning the creation of standard sources and detectors of vacuum UV radiation. However, the unique possibilities of synchrotron radiation of electron accelerators and especially accumulators as intensity standards in the vacuum part of the spectrum have not been adequately investigated. Very few papers have dealt with absolute calibrations in the vacuum UV region using synchrotron radiation and nothing has been published on calibration using the synchrotron radiation of electron accumulators. (It is mentioned in the text that such work is now being done using the SURF apparatus at the National Bureau of Standards.) But it is specifically the latter procedure which affords exceptional possibilities as radiometric standards in the vacuum region. It is demonstrated here that the use of the radiation of electron accumulators will in essence make it possible to achieve "optical" accuracies in the UV- and X-ranges of about  $\pm 0.5\%$  in absolute calibrations of spectral apparatus.

[392]

#### METHOD FOR DETERMINING ADJUSTABLE ELEMENTS IN RECTIFICATION OF SPACE PHOTOS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 2, 1978 pp 44-50

[Article by G. B. Goniñ and A. P. Boldyreva, "Simplified Graph-Analysis Methods for Determining Adjustable Elements in the Rectification of Space Photographs"]



[Abstract] The authors describe simplified methods for the rectification of space photographs in which it is possible to dispense completely or in part with the use of electronic computers and corresponding equipment. The article proposes several variants for obtaining initial data, depending on what part of the earth's surface is shown on the space photograph. In the first variant it is assumed that the horizon is shown on the photo. This variant is possible when there are sufficiently great inclinations, when the survey is carried out from circumterrestrial orbits (altitudes 250-500 km). In the second variant it is assumed that the horizon is not shown on the space photo but there are some control points which can be identified and these control points can also be identified on a map. As indicated in the article, both methods can be employed using the simplest measuring and computation devices. The rectified photographs can be used only for plotting the results of a special interpretation of space photographs on the cartographic base.

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## VI. MISCELLANEOUS

### News

#### ATOMIC ICEBREAKER "SIBIR'" READIED FOR EXPEDITION AT MURMANSK

Moscow IZVESTIYA in Russian 23 May 78 p 3

[Interview by V. Shmyganovskiy with T. B. Gushenko]

[Text] During the time of the trip of the General Secretary of the Central Committee CPSU Comrade L. I. Brezhnev, Chairman of the Presidium USSR Supreme Soviet, through Siberia and the Far East, the matter was raised of a further increase in the economic potential of the eastern regions of our country, an enhancement of their role in the all-union production of industrial products, the rational use of work, power, fuel and raw materials.

In this connection great importance is being given to the work of transportation, including the sea fleet which services the shores of the Arctic Ocean. Seamen are stubbornly searching for ways to make the most effective use of it. Now at Murmansk preparations are being made for a complex high-latitude expedition of the new Soviet atomic icebreaker "Sibir'." For the first time in history it will guide a freighter along the entire route of the Northern Sea Route at an unusually early time and will attempt to return to the west by an extremely short, previously untested route, through the continuous ice, through regions not far from the North Pole.

Prior to this voyage V. Shmyganovskiy, a special IZVESTIYA correspondent, met with T. B. Guzhenko, Hero of Socialist Labor, Minister of the USSR Maritime Fleet, and asked him to tell about the tasks and goals of the unique ice experiment.

"Calculations show that in the coming decades the maritime fleet will remain the principal type of transportation for the territories adjacent to the Northern Sea Route," said Timofey Borisovich. "This is a gigantic region with an extent of 7,000 km, a region of transformations on an enormous scale. Seamen see their principal task here to be the uninterrupted delivery of freight."

"Northerners, and indeed, the entire country, have just witnessed with delight the work feats of the icebreaker 'Kapitan Sorokin' and the diesel-electric 'Pavel Ponomarev' and 'Navarin' with freight for the Norilsk Mining-Metallurgical Combine. What has this spring voyage demonstrated?"

"In actuality a remarkable event has taken place: it has been demonstrated that there can be year-round navigation in the Arctic along the line Murmansk-Dudinka. Making possible such navigation along the entire route is the principal goal of all the experimental voyages of the fleet, including the voyage last year of the 'Arktika' to the North Pole and the present voyage of the atomic-powered 'Sibir'."

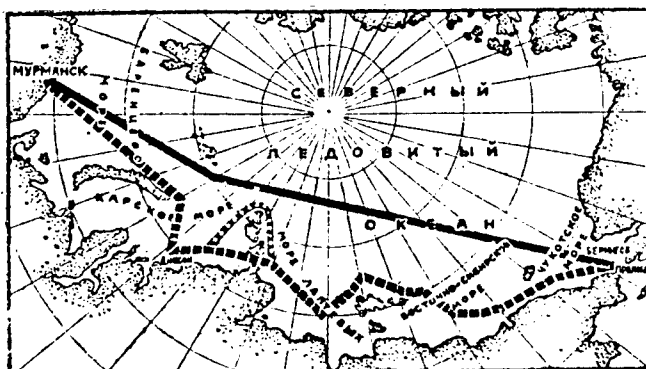
Now we will return to the recent voyage to the Taymyr. About 12,000 tons of freight were delivered here for Norilsk, for the Nadezhdinskiy Metallurgical Plant which is under construction here. In turn, by almost a quarter-year ahead of time there was outward shipment of copper and nickel to consumers. In other words, the valuable production did not lie as a dead weight in storehouses, awaiting the summer and creating enormous difficulties for the combine and its customers, but was sent on its way in good time. At the same time the delivery of freight from Murmansk will help transpolar enterprises in contending with the curse of all remote northern enterprises -- unfinished production. There will no longer be a need in autumn for creating reserves of those materials which will not be needed until spring.

Here some figures must be cited. Whereas 600,000 tons of freight were transported along the route Murmansk-Dudinka in 1970, during the past navigation season a total of 2,100 tons was delivered. It was proven feasible to conduct ships during any winter frosts, during the polar night. Just in the period of the ice going-out and high water, when the waters of the Yenisey rise 12-14 meters and the wharves at Dudinka are inundated (such is a peculiarity of this port), the navigation work virtually came to a standstill.

"How do you evaluate the prospects for early navigation through the Arctic Ocean to the Pacific Ocean?"

"In particular, such voyages will be of inestimable assistance to the national economy of formerly remote regions of our motherland -- Kolyma, Chukotka, Kamchatka, Sakhalin...Indeed, in those places where the 'Sibir' is to pass at the beginning of June, ships from the western USSR have appeared only in August. The following circumstance must be borne in mind. The maritime fleet, as is well known, is cooperating more and more closely with the railroaders of the country in the delivery of freight and we see the heavy load under which the Trans-Siberian Railroad operates. When the Baykal-Amur Railroad is put into operation the scale of this transport will increase sharply. But even now it can be foreseen that this line will not be able to satisfy completely the entire need, especially for the northeastern regions of the country. After all, the Baykal-Amur Railroad will put into production both Udokanskaya copper, and southern Yakutian coal and an enormous forest industry."

"At present the freight dispatched by railroad, to Chukotka, for example, at times is subjected to 16 reloadings and in many cases just 'sits' along the route. Everywhere storehouses are required for this material to be reloaded and upon arrival in ports there are not always ships available. Direct communication along the Arctic sea route will exclude such confusion and will greatly facilitate the work of people in the Far East."



Sketch map of movement of "Sibir" icebreaker together with "Kapitan Myshevskiy" (dashed line) and by itself (solid line).

"The 'Sibir' is leading the freighter 'Kapitan Myshevskiy' which is carrying equipment for Magadan. If the experiment is successful, and I myself have virtually no doubt of this, the cost of the freight delivered in the future to the Far East will differ little from the cost of delivery by railroad. The second part of the experiment will be a straight voyage, reducing the route to the Bering Sea by 1,000 miles (almost 1,900 km). It is speculated that in the future this route could be used successfully in supplying Far Eastern regions by two large vessels which travel in the company of an icebreaker. The designs for such vessels have already been drawn up. In this case the cost of freight delivery will be even lower than by railroad."

"We are confident of the powerful technology which the country has given us," said Timofey Borisovich Guzhenko in conclusion, "and, to be sure, we have confidence in our people. The expedition is headed by the experienced polar navigator B. Maynagashev. The 'Sibir' is under the command of Captain V. Kochetkov, and the freighter is commanded by Captain T. Krivokhizhin. On board there will be scientists and specialists. Along the entire track great assistance will be given by our famed polar aviators and weathermen. The voyage will be very difficult. I will only say that several variants have been laid out for overcoming the sectors with the most difficult ice conditions. But this experiment is necessary to the country and the entire national economy."

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